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SPECIFICATION

SEPARATION MEMBRANE FOR BATTERY

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a separation membrane used in a battery, and more particularly to a separation membrane having nanosized holes.

2. Description of Prior Art

[0002] Batteries are commonly used in various applications for conversion of chemical energy to electrical energy. Batteries can be broadly categorized into electro-chemical batteries, fuel cells and solar batteries. Electro-chemical batteries can be categorized into primary batteries and rechargeable batteries. Rechargeable batteries such as lithium ion batteries have been in increasing demand in recent years, especially for portable notebook computers, digital cameras, MP3 players, and in mobile phone applications.

[0003] As a basic component of a rechargeable battery, a separation membrane plays an important role in determining the capacity, recycle lifetime and current density of the rechargeable battery. The separation membrane is positioned between an anode electrode and a cathode electrode, and allows ions to pass therethrough while blocking electrons from passing therethrough.

[0004] A conventional separation membrane is usually made from a polyolefin, such as polyethylene, polypropylene or polystyrene. All of these materials may be harmful to the environment because of their inherent characteristics such as poisonousness, flammability and so on. In addition, during manufacturing of a polystyrene separation membrane, organic solvent containing polystyrene is evaporated and pollutes the environment. Furthermore, polyolefin is a hydrophobic material, and is not dissolved in electrolyte very well. Therefore a separation membrane made from polyolefin cannot absorb large volumes of electrolyte, and has limited capability for transferring ions therethrough. Therefore, the large current charge/discharge performance of a battery with a polyolefin separation membrane is correspondingly limited.

SUMMARY OF THE INVENTION

[0005] Accordingly, an object of the present invention is to provide a hydrophilic separation membrane having great capability of transferring ions.

[0006] Another object of the present invention is to provide a battery with a hydrophilic separation membrane having great capability of transferring ions.

[0007] In order to achieved the objects set above, a separation membrane in accordance with a preferred embodiment of the present invention comprises a plurality of composite layers attached to each other with adhesive. Each composite layer comprises a plurality of molecular layers. Each molecular layer

comprises carbon atoms forming a plurality of hexagon units, and lithium ions intercalated therein. The carbon atoms attract the lithium ions by dangling bonds. A thickness of each composite layer is in the range from 500 nanometers to 500 microns. A thickness of the separation membrane is about 1 millimeter. The separation membrane of the present invention shows hydrophilic characteristics, and is capable of absorption of large volumes of electrolyte. Therefore, the separation membrane can greatly facilitate transmission of lithium ions therethrough.

[0008] Other objects, advantages and novel features of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a schematic, isometric view of a separation membrane according to the preferred embodiment of the present invention; and

[0010] FIG. 2 is a schematic front elevation of a molecular layer of the membrane of Fig. 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0011] Referring to FIG. 1, a separation membrane 1 in accordance with the

preferred embodiment of the present invention is substantially a laminated structure being composed of carbon atoms 2 (C) and lithium ions 3 (Li^+). The separation membrane 1 comprises a plurality of composite layers 10 attached to each other with adhesive 12. Each composite layer 10 includes a plurality of molecular layers 14. Each two adjacent molecular layers 14 are held together by van der Waals forces. A thickness of each composite layer 10 is in the range from 500 nanometers to 500 microns, and is preferably 100 microns. The number of composite layers 10 is in the range from 5 to 20, and is preferably 10. Therefore, a preferable thickness of the separation membrane 1 is 1 millimeter.

[0012] Referring to FIG. 2, each molecular layer 14 substantially comprises a plurality of equilateral triangle units 16. Each equilateral triangle unit 16 has three lithium ions 3 located at three vertexes thereof respectively, and a carbon atom 2 located in a center thereof. A nanohole 18 is defined in a middle of each equilateral triangle unit 16. A length of each side of the equilateral triangle unit 16 is in the range from 25 nanometers to 100 nanometers, and is preferably 50 nanometers. Each carbon atom 2 is sp^2 hybridized and forms a covalent bond with each neighboring carbon atoms 2. In addition, each carbon atom 2 is capable of attracting lithium ions 3 from electrolyte, because of dangling bonds of the carbon atom 2.

[0013] It is noted that from another point of view, each molecular layer 14 comprises a plurality of equilateral hexagon units. Each equilateral hexagon unit

has six carbon atoms located at six vertexes thereof respectively, and six lithium ions intercalated therein. A length of a diagonal of the equilateral hexagon which passes through a middle thereof is in the range from 50 nanometers to 200 nanometers, and is preferably 100 nanometers.

[0014] It is also noted the molecular layer 14 is preferably made from carbon, yet other materials can be used instead of carbon. For example, materials such as silicon, germanium, silicon carbide, silicon oxide, compositions of carbon and silicon carbide, and compositions of silicon and germanium are also suitable.

[0015] The separation membrane 1 of the present invention shows hydrophilic characteristics, and is capable of absorption of large volumes of electrolyte to facilitate transfer of ions therethrough. In addition, each molecular layer 14 having the nanoholes 18 defined therein forms a linked net having a very high cavity density. The linked net structure increases a surface area of the molecular layer 14 and further increases absorption of electrolyte.

[0016] It is understood that the invention may be embodied in other forms without departing from the spirit thereof. Thus, the present examples and embodiments are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.